

CHAPTER 3

NON-DISCHARGING (CONTAINMENT) SYSTEMS

Non-discharging systems may be preferred or the only option in areas where the use of onsite wastewater management systems may not be feasible. Collection and processing of human waste without water can reduce the size of wastewater management systems and produce a material that can be used for landscaping purposes. The amount of maintenance required and the level of sophistication involved should be considered carefully when selecting such systems. Systems considered in this section include: (1) composting toilets, (2) incinerating toilets, and (3) vault toilets and holding tanks.

3-1 Composting toilets

Composting toilets are also known as dry toilets, moldering toilets, waterless toilets, and biological toilets. There are a wide variety of styles and configurations available, ranging from simple bucket-type systems to multi-toilet centralized composting systems. In general, these systems are more common in countries interested in ecological sanitation and in areas that have limited water resources for toilet flushing. In most composting systems, food waste is a natural addition. There are several ways to define composting toilet systems, including (1) by the location of the composting unit relative to the toilet (self-contained vs. centralized), (2) by the method in which the material is composted (continuous vs. batch), and (3) by the level of sophistication (passive vs. intensive). These concepts are discussed below.

Location of the composting unit

Self-contained systems are basically an integrated toilet seat positioned over the composting reactor. These units are generally easy to install because they sit on the floor and require only a vent pipe and leachate effluent tube. Centralized systems are somewhat more complex because the composting unit is located in a separate area, somewhat independent of the toilet. The most common example of this configuration is locating the composting unit in a basement with the toilet on the floor above. Depending on the method of waste transport (i.e., gravity, water, air pressure), the toilet may be directly above, offset above, or on the same level as the composting unit.

Method of composting

Continuous composting systems are based on the principle that new material is added to the top of the composting mass and finished material is removed from the bottom. The concern with this type of system is that the material removed from the bottom, presumably finished, may be contaminated with freshly deposited material. Batch composting systems make it less likely for contamination to occur. Material is collected for a period of time and then set aside for months or years while the composting process occurs.

Level of sophistication

Passive systems use little or no electricity, are manually turned or not turned at all, and collect urine in a separate container for alternate use. Intensive systems utilize electro-mechanical systems for turning and mixing the composting material, leachate evaporation, moisture content regulation, and air circulation.

3-1.1 Aquatron

Category	Non-discharging
Technology	Continuous composting toilet system
Input	Wastewater directly from toilet
Function	Aerobic decomposition; disinfection of liquid
Applications	Individual systems, larger buildings

Background/description of process

The Aquatron composting toilet uses a small amount of water to transport toilet waste through a solid/liquid separation device. The solids are sent to a chamber for composting (with or without worms), and the liquid is passed through a UV disinfection unit. The liquid may then be discharged with household greywater.

System footprint

The liquid/solid separation device is located in a basement or lower level. For a household or other small application, the separation and composting unit is about 2 ft in length, 2.3 ft in width, and 4.3 ft in height. A small UV disinfection unit may also be used. Toilets are located above the separation/composting unit and drain by gravity.

Advantages

The Aquatron composting toilet systems utilize standard 1 to 1.5 gal/flush toilets. Solids are separated in-line and composted. A septic tank is not required.

Disadvantages

System may require more maintenance than a standard septic system. Need for effluent and greywater management still exists. Odors and clogging issues will need to be addressed if they develop.

Performance

Efficient process for solids separation and composting. System effluent is disinfected and amenable to greywater usage. Composted material may be used in garden or further composted before use in garden (depending on Aquatron model).

Operation and maintenance

System contents (composted solids) will need to be emptied occasionally, depending on use, typically once every year or two. If needed, worms will need to be added during system start-up. UV lamps will need to be changed periodically (every 4 or 5 years). System should be periodically inspected for clogging, insufficient liquid separation, or other malfunctions.

Power and control

The only power requirement is for UV disinfection system (2 bulb system). If unit is located below greywater system, a pump will be needed to move the liquid.

Contact

Aquatron International AB
Box 2086, SE-194 02
Uplands Vasby, Sweden
Phone +468 590 304 50
Fax +468 590 304 94
E info@aquatron.se
Web www.aquatron.se
Model description

Aquatron 90, suitable for vacation/leisure homes or small households
Aquatron 4x100, full composting, suitable for vacation/leisure homes or small households
Aquatron 400, suitable for year-round households (or vacation homes)
Aquatron 4x200, full composting, suitable for year-round households
Aquatron 4x300, full composting for schools, day-care centers etc
Aquatron 1200, suitable for schools, day-care centers, small office buildings etc
Aquatron 3000, suitable for installations in particularly sensitive environments
Aquatron ALE, toilet and organic waste composting for large residential buildings

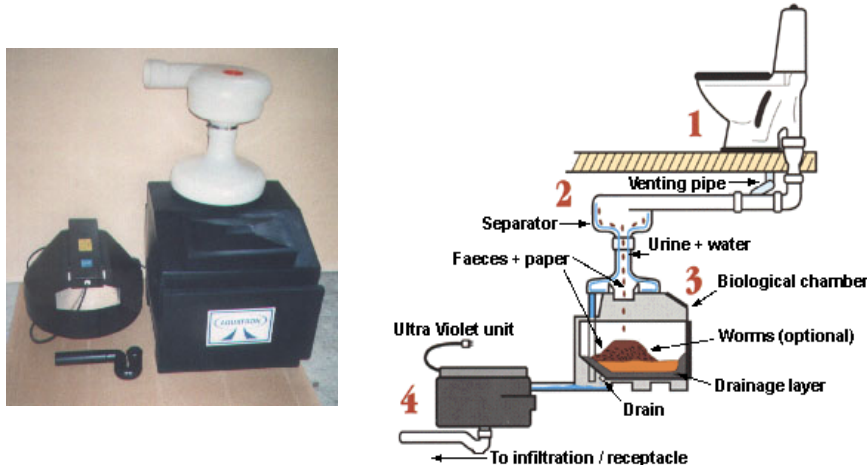


Figure 3-1

The Aquatron system for liquid/solid separation of human waste and biological composting. (Adapted from Aquatron International AB.)

References and other resources

Del Porto, D., and C. Steinfeld (1999) *The Composting Toilet System Book*, the Center for Ecological Pollution Prevention, Concord MA

3-1.2 Biolet

Category	Non-discharging
Technology	Continuous composting toilet system
Input	Excrement and toilet paper
Function	Aerobic decomposition; liquid evaporation
Applications	Single home and small community residential systems

Background

BioLet composting toilets are on-site, self-contained, biological toilets, where human waste (feces, urine, and toilet paper) are collected, excess liquid is evaporated, and solid material is composted.

Description of process

Material is deposited directly into the composting chamber. A mixing arm turns the material to enhance the composting process. Finished compost falls through a screen and collects in a removable tray, and the leachate is evaporated by a small heater. A small fan is used to pull air through the unit and exhaust odors out a vent pipe. A view guard in the bottom of the toilet bowl hides the composting contents and opens automatically upon seat pressure.

System footprint

A small, self-contained unit. Typical dimensions are about 2.75 ft in length, 2.2 ft in width, and 2.25 ft in height. Additional space is needed for removing the drawer.

Advantages

It is a small unit, and is relatively inexpensive and easy to install. Toilet waste does not require any other management because all contents are composted or evaporated in the unit. The view guard improves aesthetics of the toilet. An exhaust fan helps to prevent odors. Previously NSF approved. Some units are available that do not use electricity.

Disadvantages

Contents will not be completely composted if overloaded. Electrical and moving components may fail and will eventually need to be replaced.

Performance

Material discharged includes finished compost and exhaust air. If overloaded, excess leachate and uncomposted materials will also need management. Finished compost less than 200 FC/g (per NSF standards).

Operation and maintenance

Composted material will need to be emptied several times a year under normal operating conditions. An amendment material is added to the unit at start-up and after each use. System should be inspected regularly for component failure or other operation problems. Incompletely composted material and leachate will need to be handled properly in case of overloading or improper operation.

Power and control

Electric units may have a 25 W exhaust and air circulation fan, a 40 W mixer motor, and 305 W heaters. Annual electrical usage expected to be 500 to 600 kWh. Non-electric units are manually operated and have no electricity usage.

Cost

Retail cost from \$1000 to 1600, not including delivery and installation.



Figure 3-2

BioLet XL (electric) and the Biolet NE (non-electric). (Adapted from Biolet USA.)

Contact

Biolet USA, Inc.
150 East State St.; PO Box 548
Newcomerstown, OH 43832
Phone (800) 524-6538
Fax (740) 498-4073
E info@biolet.com
Web www.biolet.com

Real Goods
13771 South Hwy 101
Hopland, CA 95449
Phone (707) 744-2100

Model description

Toilet	Full-Time	Part-Time	Type	Cost
BioLet XL	4 People	6 People	Electric	\$1599
BioLet Deluxe	3 People	4 People	Electric	\$1499
BioLet Standard	3 People	4 People	Electric	\$1399
BioLet Basic	2 People	3 People	Non-Electric	\$999
BioLet NE	4 - 6 People	4 - 6 People	Non-Electric	\$999

Manufacturer support

Three year limited warranty and phone customer support.

References and other resources

BioLet product brochure; available from www.biolet.com.

Del Porto, D., and C. Steinfeld (1999) *The Composting Toilet System Book*, the Center for Ecological Pollution Prevention, Concord MA

3-1.3 Bio-Recycler

Category	Non-discharging
Technology	Continuous composting toilet system
Input	Excrement, toilet paper
Function	Aerobic decomposition; liquid evaporation; worm composting optional
Applications	Residential, sensitive areas

Background/description of process

System features a vacuum collection system, allowing the composting chamber to be located away from the building.

Advantages

Remote placement of composting chamber may reduce aesthetic concerns.

Disadvantages

Uses a compressor to power vacuum system

Contact

Bio-Recycler Co.
5308 Emerald Dr.
Sykesville, MD 21784
Phone (410) 795-2607

3.1-4 Bio-Sun®

Category	Non-discharging
Technology	Continuous feed composting toilet system
Input	Excrement, toilet paper, food waste
Function	Aerobic decomposition; liquid evaporation
Applications	Residential, institutional, commercial system, custom designed

Background/description of process

Materials to be composted are deposited into the compost chamber located below, generally in a basement. An air blower is used to provide positive aeration and accelerate the composting process.

System footprint

Custom made systems convert a portion of a concrete basement into an aerobic composting chamber. Systems are adapted to needs and space available.

Advantages

Aeration potentially results in faster composting process.

Disadvantages

Blower may be expensive if used continuously.

Operation and maintenance

Composting material must be raked to obtain even distribution in the composting chamber. Composted material will need to be removed occasionally.

Power and control

Blower used to provide positive aeration, no heating required.



Figure 3-3

Diagram of the residential Bio-Sun composting toilet system. (Adapted from Bio-Sun Systems, Inc.)

Contact

Bio-Sun Systems, Inc.
Box 134A, Rd #2
Millerton, PA 16936
Phone (800) 847-8840; (570) 537-2200
Fax (570) 537-6200
E bio-sun@ix.netcom.com
Web www.bio-sun.com

References and other resources

Del Porto, D., and C. Steinfeld (1999) *The Composting Toilet System Book*, the Center for Ecological Pollution Prevention, Concord MA

3-1.5 *Clivus Multrum*

Category	Non-discharging
Technology	Continuous composting toilet system
Input	Excrement, toilet paper, food waste
Function	Aerobic decomposition; worm composting
Applications	Residential, institutional, sensitive areas

Background/description of process

One of the oldest and best known composting toilet systems. The composting chamber has a sloped floor, allowing material to compost as it moves down the reactor over time. The composting chamber is large, promoting long retention times for thorough composting. Finished material is removed by opening a door at the bottom end of the composter and removing the contents. Leachate drains and is collected from the bottom of the unit.

System footprint

System size varies depending on the unit selected (see model description below). Basic residential system is configured with composting reactor located in basement with toilet located directly above, with material falling directly into the composting system.

Advantages

The large composting chamber allows for longer composting times. Company is well established and NSF approved, possibly being easier to permit in some areas. Flushing system uses no or very little water.

Disadvantages

Continuous flow design could result in insufficient composting due to premature mixing. Toilet must be located directly above with composting unit. Excess leachate must be managed.

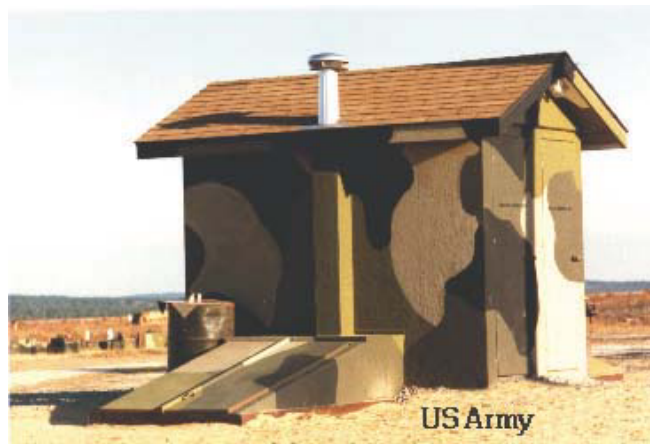


Figure 3-4

Clivus Multrum composting units, in-home residential system and system housed in separate building. (Adapted from Clivus Multrum, Inc.)

Performance

NSF approved system.

Operation and maintenance

Periodic compost removal, inspection, and cleaning.

Power and control

Process control devices include a fan to exhaust the composting chamber, water application to maintain correct composting moisture content, and a pump to remove accumulated leachate.

Cost

Residential systems range from about \$2,500 to 5,000 (not including shipping and installation).

Contact

Clivus Multrum Inc.

15 Union Street

Lawrence, MA 01840

Phone (978) 725-5591

Fax (978) 557-9658

Web www.clivusmultrum.com

Model description (NSF certified models)

Model	Uses/day	Dimensions
Model M-1	10	height = 56 in; width = 33 in; length = 65 in
Model M-2	15	height = 66 in; width = 33 in; length = 65 in
Model M-12	80	height = 58.5 in; width = 62 in; length = 105 in
Model M-15	100	height = 99.5 in; width = 41 in; length = 119.5 in
Model M-18	120	height = 83 in; width = 62 in; length = 105 in
Model M-22	80	height = 64 in; width = 62 in; length = 115 in
Model M-25	100	height = 98.5 in; width = 41 in; length = 122 in
Model M-28	120	height = 89.5 in; width = 62 in; length = 115 in
Model M-32	110	height = 67 in; width = 70.5 in; length = 103 in
Model M-35	180	height = 89 in; width = 70.5 in; length = 103 in
Model M54ADA	60	composting toilet system inside of a building

References and other resources

Del Porto, D., and C. Steinfeld (1999) *The Composting Toilet System Book*, the Center for Ecological Pollution Prevention, Concord MA

3-1.6 Composting toilet (site built)

Category	Non-discharging
Technology	Site-built composting toilet
Input	Excrement, toilet paper, food waste
Function	Aerobic decomposition; liquid evaporation
Applications	Residential, sensitive areas

Background/description of process

Plans are available for many types of composting toilet systems that can be built onsite. Systems are generally simple batch or continuous composting systems, requiring little or no electrical input. Common systems utilize 55 gallon drums or other large containers for collection and composting of material.

System footprint

Typical systems are composed of a toilet stool located above the compost reactor. The composting unit may be located outside of the building or in the basement. The reactor can be as simple as a 55 gal drum or wheeled container housed inside of a wood structure.

Advantages

Simple and inexpensive system to construct, many popular designs available. Can be constructed in part from salvaged materials.

Disadvantages

Requires regular operation and maintenance, depending on the specific type of system and usage. Not approved through NSF type certification. May be difficult to get approved by regulatory agencies. Design and construction not uniform.

Performance

Will vary depending on system type and usage.

Operation and maintenance

Typical operation and maintenance may include the exchange and emptying of receptacles upon filling, inspection for proper operation, and the addition of an amendment material to enhance the composting process.

Power and control

A small exhaust fan is generally used to disperse odors, if used intermittently, energy usage is minimal.

Cost

Depends on cost of plans and materials used, but typically \$500 to 1,000, not including labor.



Figure 3-5

Site built batch drum composting toilet system.
(Adapted from the Lama Foundation)

Contacts

Center for Ecological Pollution Prevention
P.O. Box 1330
Concord, MA 01742 USA
Phone (978) 318-7033
Web www.cepp.cc

National Water Center
5473 Hwy 23N
Eureka Springs, AR 72631
Phone (501) 253-9431
E peace@ipa.net
Web www.nationalwatercenter.org

The Center for Innovation in Alternative Technologies
Ave. San Diego No. 501
Col. Vista Hermosa, C.P. 62290 MEXICO
Phone (52-7) 322-8638
E cita@central.edsa.net.mx
Web www.laneta.apc.org/esac/citaing.htm

References and other resources

Del Porto, D., and C. Steinfeld (1999) *The Composting Toilet System Book*, the Center for Ecological Pollution Prevention, Concord MA

Oasis Design (<http://www.oasisdesign.net>)

Van der Ryn, S. (1995) *The Toilet Papers: Recycling Waste and Conserving Water*, Ecological Design Press.

3-1.7 CTS

Category	Non-discharging
Technology	Continuous composting toilet system
Input	Excrement, toilet paper, food waste
Function	Aerobic decomposition
Applications	Sensitive and remote areas

Background/description of process

The CTS composting system is similar in operation to the Clivus Multrum composting toilet. A waterless toilet is located directly above composting chamber. As material is deposited into the composting unit, it gradually moves down an incline while composting. Finished compost is removed from the bottom of the unit.

System footprint

Toilet must be located directly above the composting unit, for dimensions see model descriptions below.

Advantages

Relatively simple composting process with very few moving parts. Flushing system does not use water. Design adapted to remote areas and minimal maintenance.

Disadvantages

Continuous composting system is susceptible to contamination of finished compost with freshly deposited material.

Performance

Previously NSF approved.

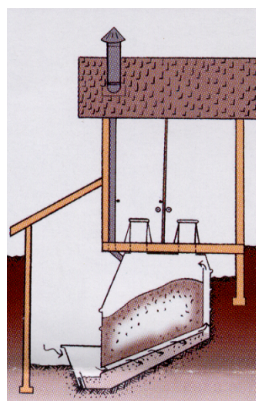


Figure 3-6

A diagram of the CTS composting toilet system (left) and a system installed in a remote area. (Adapted from CTS, Inc.).

Operation and maintenance

Finished compost will need to be removed from the unit periodically, system components should be inspected regularly for proper operation.

Power and control

An AC or DC/solar fan is used to promote air flow and exhaust odors. Fire suppression kits are also available for controlling temperature and moisture content.

Cost

Basic system (CTS 410) costs around \$4,500 for the complete system.

Contact

Composting Toilet Systems, Inc.

PO Box 1928

Newport WA 99156-1928

Phone (509) 447-3708; (888) 786-4538

Fax (509) 447-3708

E cts@povn.com

Model description

Model	Uses/day	Dimensions
CTS 410	18	width = 4 ft; length = 9 ft; height = 6 ft;
CTS 710	40	width = 4 ft; length = 9 ft; height = 7 ft;
CTS 1010	75	width = 4 ft; length = 9 ft; height = 8 ft;
CTS 904	80	width = 5 ft; length = 9 ft; height = 5 ft;
CTS 914	120	width = 5 ft; length = 9 ft; height = 7 ft;

Manufacturer support

Five year limited warranty.

References and other resources

CTS product brochure

3-1.8 EcoTech Carousel

Category	Non-discharging system
Technology	Batch composting toilet
Input	Excrement, toilet paper, food waste
Function	Composting solids, liquid evaporation
Applications	Residential, sensitive areas

Background/description of process

Material is deposited directly into one chamber of a multi-sectioned composting chamber. Liquid passes through the perforated bottom into an evaporation chamber. After one section of the composter fills, the carousel is rotated so that an empty chamber may begin collecting waste.

System footprint

Small, medium, and large composting carousel sizes are available, depending on needs.

Medium sized unit is approximately 25 in high with a diameter of 52 in, while the larger unit is 52 in tall with a diameter of 52 in.

Advantages

Batch style composting does not mix fresh material with finished compost material. The large composting chamber can accept material for long period of time before needing to be emptied.

Disadvantages

Composted material must be periodically removed from the composting chamber.

Performance

Large model previously NSF approved under standard 41.

Operation and maintenance

After two years of accumulation, composting chambers will need to be emptied every three months to one year. System will need to be checked to ensure proper operation of exhaust fans and heaters.

Power and control

Electrical components can include exhaust fans and heater. The carousel is rotated manually. Estimated 200 to 400 kWh annual power requirement.

Cost

Estimated cost for the composting system range from \$2,100 to 3,500 (does not include toilet stool, installation, or delivery).



Figure 3-7

Diagrams of the EcoTech Carousel composting toilet. (Adapted from EcoTech.)

Contact

Ecotech
PO Box 1313
Concord, MA 01742-2968
Phone (978) 369-3951
E ecotech@ecological-engineering.com
Web www.ecological-engineering.com/ecotech/carousel.html

Model description

Small	2 people year round, 12 people weekend/vacation use
Medium	3 people year round, 15 people weekend/vacation use
Large	5+ people year round, 32 people weekend/vacation use

References and other resources

Del Porto, D., and C. Steinfeld (1999) *The Composting Toilet System Book*, the Center for Ecological Pollution Prevention, Concord MA

3-1.9 Envirolet™

Category	Non-discharging
Technology	Continuous composting toilet system
Input	Excrement and toilet paper
Function	Aerobic decomposition; liquid evaporation
Applications	Residential, mobile applications

Background/description of process

The Envirolet composting toilet system is available in two basic configurations: self-contained and remote composting. The self-contained models sit directly on the floor and the material is composted in the unit. For the remote system, the composter is located in a separate area (e.g., outside or in a basement) and waste material is transported using a small amount of water. Features include a manual mixer and raking bar to enhance the composting process and heaters and fans to circulate warm air and exhaust odors.

System footprint

Self contained systems are relatively small, see model description details below.

Advantages

Manually operated door in toilet bowl allows for easy stand-up use. System is relatively small and inexpensive. Electrical and non-electrical units available. CSA (NSF 41) approved.

Disadvantages

Continuous composting system may result in contamination. Heater and fan system may dry out material, inhibiting composting process. Accumulated leachate will need to be managed.

Performance

CSA certified (NSF 41).

Operation and maintenance

Operation consists of adding peat moss or other amendment to process daily, periodic cleaning, and removal of composted contents. Regular monitoring and maintenance is also recommended, including inspection of electrical components.

Power and control

For electric models, fan (40 W) and heater (540 W) are both used. Electricity usage depends on length of operation. Non-electric models do not require electricity.

Cost

Self-contained units range in cost from about \$1,000 to 1,300, while remote composting units range from \$1,400 to 1,600 (includes composting unit, toilet, and accessories).

References and other resources

Del Porto, D., and C. Steinfeld (1999) *The Composting Toilet System Book*, the Center for Ecological Pollution Prevention, Concord MA

Contact

Sancor Industries Ltd.

140-30 Milner Ave.

Scarborough, Ontario, Canada, M1S 3R3

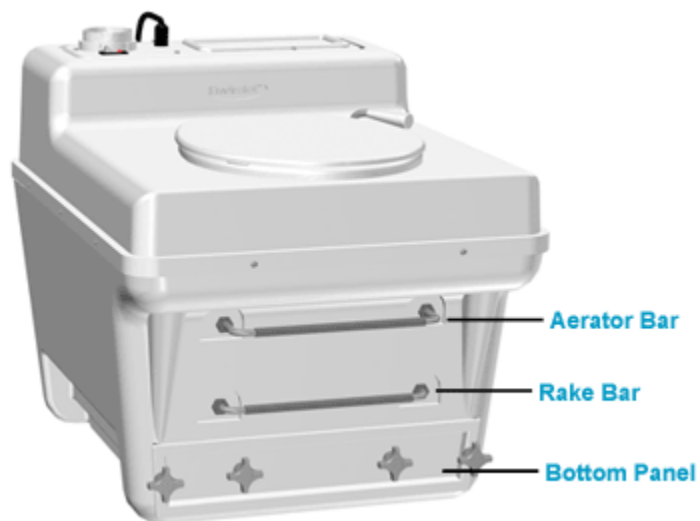
Phone 800.387.5126

Web www.envirolet.com**Model description**

Model	Uses/day	Dimensions
Self-contained; waterless		
Basic Plus (non-electric)	6	All self-contained units:
DC12 (battery or solar power)	12	Width = 25 in; Length = 33 in;
MS10 (120 VAC electric power)	18	Height = 25 in
SC Hybrid (120 VAC or 12 VDC)	12	
Remote composting systems; waterless		
W/RS/NE (non-electric)	12	All remote units: Width = 25 in;
W/RS/12VDC	18	Length = 33 in; Height = 28.5 in
W/RS/120VAC	24	Waterless toilet: Width = 16.5
W/RS/12VDC/120VAC	21	in; Length = 22.5 in; Height = 20.5 in
Remote composting systems; low-water		
LW/RS/NE (non-electric)	12	All remote units: Width = 25 in;
LW/RS/12VDC	18	Length = 33 in; Height = 28.5 in
LW/RS/120VAC	24	Waterless toilet: Width = 15.25
LW/RS/12VDC/120VAC	21	in; Length = 20.5 in; Height = 18.75 in

Manufacturer support

There is a lifetime warranty on the the body of Envirolet systems and a 4 year warranty on the internal components (including fans, heater, thermostats, etc.).

**Figure 3-8**

The self-contained and remote Envirolet composting toilet systems. (Adapted from Sancor Industries, LTD.)

3-1.10 Equaris Separation/Composting System

Category	Non-discharging
Technology	Continuous composting toilet system;
Input	Excrement, toilet paper, and food waste
Function	Aerobic decomposition; greywater treatment and water recycling optional
Applications	Residential, sensitive areas

Background/description of process

The Equaris system was formerly known as AlasCan of Minnesota. The system is based on separation of household greywater from toilet and food waste. The organic waste is composted in an aerobic reactor and the greywater is treated in an aerobic treatment system. After treatment, the water may be passed through a water treatment system for production of potable water.

System footprint

The composting reactor and greywater treatment systems are about 8 ft long, 6 ft wide, and 4.5 ft tall; the drinking water treatment system (water recycling) is 24 in wide x 40 in long x 72 in tall.

Advantages

A complete onsite waste treatment system that reduces the amount of water discharged to soil systems and reduces the constituent concentrations in the effluent. Remote monitoring equipment and automated controls can improve process reliability.

Disadvantages

A highly mechanized process that needs more maintenance than other simple composting toilets.

Performance

Manufacturer claims 90 percent reduction in nitrogen, BOD, and TSS in the process effluent (to soil system) and overall wastewater flow reduced by 40 percent.

Operation and maintenance

Maintenance includes adding amendment material to the composting process and periodic removal of finished compost. Greywater treatment and water recycling systems require additional maintenance.

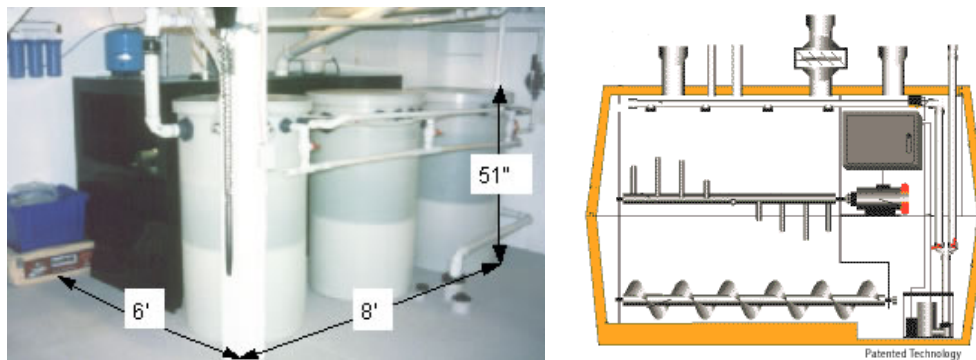


Figure 3-9

The Equaris composting and greywater treatment system (left), and a diagram of the composting reactor (right). (Adapted from Equaris Inc.)

Power and control

Electricity required to operate the fan (27 W) and process pumps. The greywater treatment

system also uses a 67 W air compressor to maintain aerobic conditions. Disinfection and water recycling system require additional electricity. Maintenance costs expected to range from \$100 to \$300 depending on complexity of system. Estimated electricity usage ranges from 400 to 450 kWh, also depending on system components.

Cost

System cost ranges from \$7,500 to 22,000 for basic composting toilet and complete waste treatment/water recycling system, respectively (not including installation costs, which range from \$1,000 to 2,000).

Contact

Equaris Corporation
1740 Magnolia Lane North
Plymouth, MN 55441
Phone (763) 383-5136
Fax (763) 383-5155
E mail@equaris.com
Web www.equaris.com

Model description

Model I	Equaris Toilet Wastes BioMatter Resequencing Converter (BMRC)
Model II	Equaris Toilet and Organic Kitchen Wastes BMRC
Model III	Equaris Toilet and Organic Kitchen Wastes BMRC and Greywater System
Model IV	Equaris Toilet and Organic Kitchen Wastes BMRC and Greywater System and and Filtration and Disinfection Potable Water Discharging System
Model V	Equaris Toilet and Organic Kitchen Wastes BMRC and Greywater System and Total Household Water/Wastewater Treatment and Recycling System

Manufacturer support

Complete remote monitoring and maintenance service available.

References and other resources

Equaris literature package (2002).

3-1.11 Phoenix Composting Toilet

Category	Non-discharging
Technology	Continuous composting toilet system
Input	Excrement and toilet paper
Function	Aerobic decomposition; liquid evaporation
Applications	Residential, remote and sensitive areas

Background/description of process

The Phoenix composting system is a remote composting system with an internal mixing mechanism. This system can be operated with waterless, gravity toilets located directly above the unit, low-flush toilets located above but with vertical offset, or vacuum flush toilets located on the same level as the composting unit. Leachate is recirculated through the system and evaporated or discharged through a drain.

System footprint

The composting unit is typically located in the basement or lower level. Dimensions are provided in the model description section.

Advantages

A large composting volume does not have to be emptied as frequently. Low power usage and compatible with waterless toilets. Suitable for off-grid applications.

Disadvantages

Continuous flow design may result in mixing of finished compost with unprocessed material.

Operation and maintenance

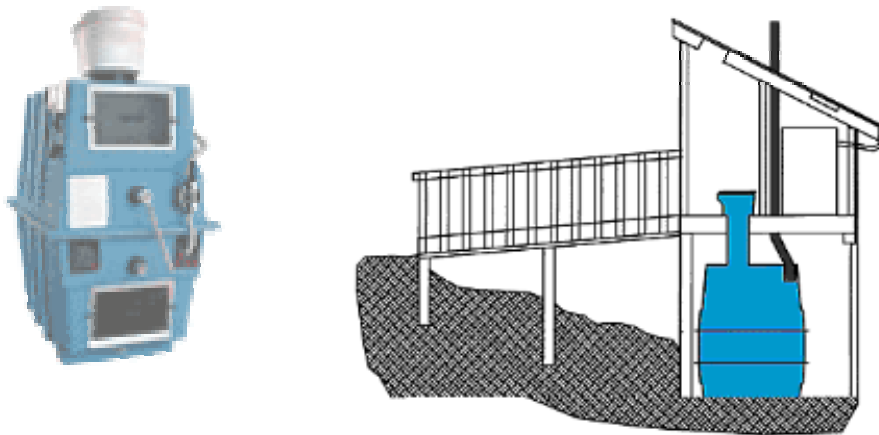
Occasional addition of amendment material and removal of composted material. Inspection of moving parts and operation. Discharge or evaporation of leachate. Periodically turning the crank for manual mixing.

Power and control

Typical electricity required to power exhaust fan ranges from 5 to 25 W. An optional evaporation system may be used to eliminate liquid discharge.

Cost

Estimated cost range from \$3,500 to 5,000 (does not include shipping or installation costs). Evaporation system costs around \$1,000. Custom made public systems housed in a building are also available.

**Figure 3-10**

Phoenix composting toilet system and standard configuration. (Adapted from Advanced Composting Systems.)

Contact

Advanced Composting Systems
195 Meadows Rd.
Whitefish, MT 59937
Phone (905) 332-1314
Fax (905) 332-1315
E phoenix@compostingtoilet.com
Web www.compostingtoilet.com

Model description

Model	Capacity	Dimensions
R199	2 people	height = 53 in; width = 40 in; length = 61.5 in
R200	4 people (30 uses/d)	height = 68 in; width = 40 in; length = 61.5 in
R201	8 people (50 uses/d)	height = 84 in; width = 40 in; length = 61.5 in

References and other resources

Del Porto, D., and C. Steinfeld (1999) *The Composting Toilet System Book*, the Center for Ecological Pollution Prevention, Concord MA

3-1.12 Sun-Mar

Category	Non-discharging
Technology	Composting toilet system
Input	Human and food waste
Function	oxidation, stabilization
Applications	Cottage, residential, boat, RV

Background

Sun-Mar corporation produces electric and non-electric, self-contained and central composting systems. The unique design features of Sun-Mar composting toilets are an internal rotating drum composter and three separate chambers for material handling.

Description of process

Human and vegetable waste is deposited in the composting drum chamber. One cup of peat moss per person per day is added to the material to be composted. Every third day the composting drum is rotated to maintain aerobic composting conditions. Gases are vented from the composting unit with a small fan or chimney. Finished compost material must be removed periodically, depending on use.

System Footprint

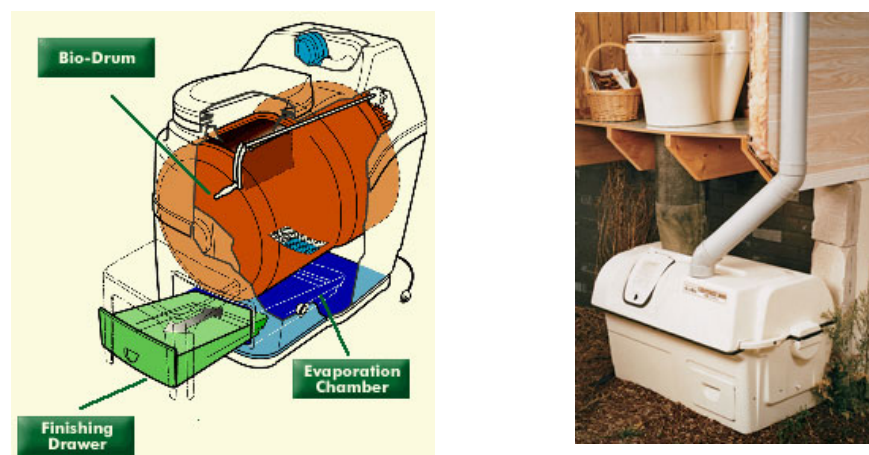
Sun-Mar composting toilets are available in self-contained and central systems. A drain line should be hooked up (optional for electric models). A vent pipe is used to exhaust gases to the atmosphere. Remote composting systems are typically utilize ultra low-flush toilets connected to a composting unit located below (e.g., in a basement). Dimensions for the self-contained and remote composting systems are provided below in the model description section.

Advantages

Well established company certified by NSF 41. Drum composting system effective for mixing and aeration of composting material.

Disadvantages

The continuous composting system may allow contamination of finished compost with newly deposited material.

**Figure 3-11**

Sun-mar self-contained and remote composting system. (Adapted from Sun-Mar Co.)

Performance

Certified by NSF under standard 41.

Operation and maintenance

Operation consists of periodic addition of amendment material and rotation of composting drum for mixing and aeration. Inspection of mechanical components.

Power and control

Electrical components include an exhaust fan (30 W) and heater (250 W). The estimated annual power usage is 1300 kWh.

Cost

Self-contained systems range from \$1,000 to 1,200. Remote composting systems from \$1,200 to 1,600 (not including shipping and installation).

Contact

Sun-Mar Corporation
600 Main St
Tonawanda, NY 14150
Phone 800-461-2461
E compost@sun-mar.com
Web www.sun-mar.com
Model description

Model	Capacity	Dimensions
Self-contained composting system		
Compact	3 to 4 people	height = 27.5 in; width = 22 in; length = 33 in
Ecolet family	3 to 4 people	height = 28 in; width = 21 in; length = 19 in
Excel AC/DC	AC 3 to 5; DC 2 to 3	height = 32 in; width = 22.5 in; length = 33 in
Excel-NE	2 to 3 people	height = 31 in; width = 22.5 in; length = 33 in
Excel	3 to 5 people	height = 31 in; width = 22.5 in; length = 33 in
Spacesaver	3 to 4 people	height = 28 in; width = 21 in; length = 19 in
Remote composting system		
1000 Series	Seasonal light/medium use by 5 to 7 people	Most units available in various styles including non-electric dry toilet, electric dry toilet, DC electric dry toilet, low-flush non-electric, low-flush electric, and DC electric low-flush
2000 Series	Seasonal medium/heavy use by 6 to 9 people; light residential use by 3 to 6 people	
3000 Series	Heavy seasonal use by 7 to 11 people; residential use by 5 to 8 people	Typical size is height = 27.5 in; width = 32 in; length = 27 in

Manufacturer support

The fiberglass body is warranted for 25 years, and the parts are warranted for 3 years.

References and other resources

Del Porto, D., and C. Steinfeld (1999) *The Composting Toilet System Book*, the Center for Ecological Pollution Prevention, Concord MA

3.1-13 Other Systems

Below is a list of additional composting toilet systems that are not as readily available in the United States as some of the systems described above.

Contacts

Enviro Loo

PO Box 219; 23 Gooraway Place
Berowra Heights, NSW 2082 Australia
Phone 02 9456 0172
Fax 02 9456 0173
E allan@enviro-options.com.au
Web <http://www.enviro-options.com.au/>
Description
An evaporation /dehydration system.

Nature Loo

P.O. Box 150 Bulimba
Queensland, Australia 4171
Phone 07 3395-6800
Fax 07 3395-5322
E info@nature-loo.com.au
Web www.nature-loo.com.au
Description
Batch-type composting toilets.

Rota-Loo

2/32 Jarrah Drive
Braeside, VIC.3195 Australia
Phone 03 587-2447
Fax 03 587-5622
E enquiries@rotaloo.com
Web www.rotaloo.com
Description
Batch type carousel composters.

Vera Miljø A/S

Postboks 2036
3239 Sandefjord
Phone 33 42 01 00
Fax 33 47 46 80
E mail@vera.no
Web www.vera.no/
Description
Several models available.

Dowmus

P.O. Box 323 Cooroy
Queensland, Australia 4563
Phone 61 074 476 342
Fax 61 074 425 228
E djrcamp@peg.apc.org
Web <http://www.dowmus.com/>

Ekosanic Scandinavia

Box 620, S-135 26
Tyresö, Sweden
Phone 468-745 06 30
Fax 468-777 45 07
E m-20071@mailbox.swipnet.se
Web www.ekosanic.a.se

Naturum

Luonto-Laite Oy
FIN-17740 Kasiniemi FINLAND
Phone 358 3 556 8132
Fax 358 3 556 8133
E luontola@sci.fi
Web www.naturum.fi/english

Contuit Dry Toilet

E conradg@cape.com
Web www.cape.com/cdt/

EKOLET Composting Toilets

Estetie 3, 00430
HELSINKI, FINLAND
Phone 358 40 5464775
Fax 358 9 5635056
E ekolet@ekolet.com
Web www.ekolet.com/

3-2 Incinerating toilets

Incinerating toilets are self-contained systems for the combustion of human waste, using gas or electricity, and resulting in a sterile ash material. Incinerating toilets may be considered in areas where biological wastewater treatment is not feasible. There are two basic types: one system combusts waste material after each use and the other system stores waste material for some period of time before batch combustion.

While these systems use no water, they do require energy (either gas or electricity) for operation. In addition, the air emissions from waste combustion systems are not known. Maintenance includes manufacturer recommended upkeep and removal of the residual ash.

3-2.1 Incinolet Electric Toilet System

Category	Non-discharging
Technology	Incinerating toilet
Input	Excrement, toilet paper
Function	Combustion of human waste
Applications	Sensitive and remote areas

Background/description of process

The Incinolet toilet is an NSF approved system for the combustion of human waste. A bowl liner is used with each use to capture human waste. The liner and waste material are then dropped into the combustion chamber by depressing a foot pedal; the combustion system is then manually activated. The waste material is reduced to a pile of ash, which is then disposed of in the trash. The combustion cycle takes about 1.5 h, but the unit can continue to be used during the combustion cycle.

System footprint

The standard unit is 15 in wide, 20 in high, and 24 in long. Additional space is required in front of the unit for removal of the ash. A vent pipe also needs to be connected to control odors and exhaust.

Advantages

Ash material can be disposed of without odor. Unit is small and easy to install. Process does not use any water, and a catalyst is used to control emissions. Waste is processed immediately, so only ash is left to dispose of.

Disadvantages

Needs electricity to operate, system will not operate during a power outage. Bowl liners must be used during each use. If incomplete combustion of the waste occurs, the uncombusted material will need to be removed from the chamber.

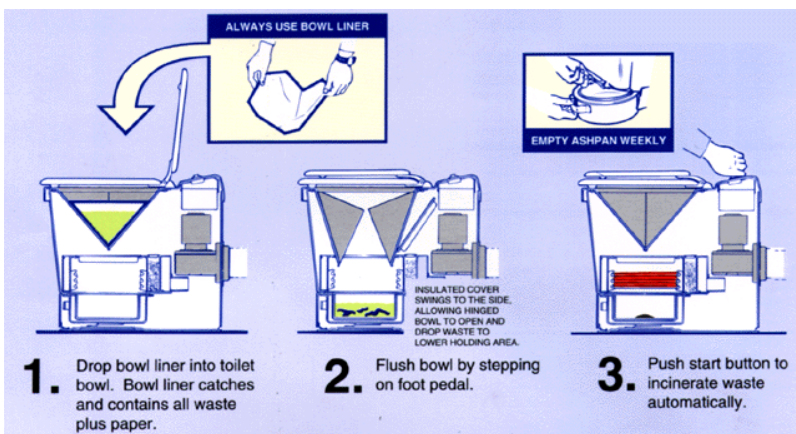


Figure 3-12

The Incinolet electric toilet system (left) and typical system operation (right). (Adapted from Research Products/Incinolet, Inc.)

Operation and maintenance

A bowl liner needs to be installed for each use. Ash must be emptied periodically, depending on usage (typically once per week). Blower must be cleaned every 90 days. Other components, such as the heater, catalyst, and switches, will need to be replaced as necessary.

Power and control

System uses approximately 0.5 to 1 kWh per usage.

Cost

Cost for Incinolet ranges from \$1600 to 2000, depending on specific model. Bowl liners are about \$0.10 each. Annual operation and maintenance costs can be expected to be several hundred dollars.

Contact

Research Products/Blankenship
26 Andjon
Dallas, TX 75220
Phone (214) 356-4238; (800) 527-5551
Fax (214) 350-7919
Web www.incinolet.com

Model description

Model	Application	Electrical needs	People
CF	Cottages/light use	120 V/1800 W	4
RV	Mobile	120 V/1800 W	4
TR	Homes/heavy use	240 V/3600 W	8
WB	Marine	120 V/1800 W; 240 V/3600 W	4 or 8

Manufacturer support

One and two year warranties, depending on the model. Phone support and sales assistance available during business hours.

References and other resources

Incinolet electric toilet system brochure (2002)

U.S. EPA (1999) Water Efficiency Technology Fact Sheet: Incinerating Toilets, EPA 832-F-99-072, Office of Water, U.S. Environmental Protection Agency, Washington DC.

3-1.2 Storburn Gas Fired Incinerator Toilet

Category	Non-discharging
Technology	Incinerating toilet
Input	Excrement, toilet paper
Function	Combustion of human waste
Applications	Sensitive and remote areas

Background/description of process

The Storburn incinerating toilet system uses propane or natural gas to combust human waste. Excrement is stored in a reservoir (3 gal), which fills after 40 to 60 uses; the waste material is then combusted as a batch. An anti-foaming agent is also added to the process before combustion. The combustion process requires about 4.5 h, during this time the toilet can not be used.

System footprint

Unit is 17.75 in wide, 31.25 in long, and 53 in tall, however 43 in of space is required above the unit. A vent pipe is also needed.

Advantages

May be convenient in remote locations or where waste discharge is not acceptable. Does not use water or electricity. Few moving parts reduce maintenance needs.

Disadvantages

Requires natural gas or propane to operate. Can not be used during incineration cycle.

Operation and maintenance

Anti-foam agent is added before the combustion cycle and ash is emptied after the combustion cycle. Periodic cleaning of the burner is needed.

Power and control

About 10 to 16 complete burn cycles (40 to 60 uses per cycle) can be accomplished with a full 100 lb propane cylinder. Conducting the combustion cycle after the chamber is full is more fuel efficient than combusting partial loads.

Cost

Propane and natural gas fired toilets cost about \$3,000 (not including shipping and installation). The vent kit is around \$300 and the anti-foam agent is \$25 for 24 packets.



Figure 3-13

The Storburn incinerating toilet. (Adapted from Storburn International Inc.)

Contact

Storburn International Inc.
47 Copernicus Blvd., Unit 3
Brantford Ontario, N3P 1NA, Canada
Phone (519) 752-8521
Fax (519) 752-5872
Web www3.sympatico.ca/storburn/products.htm

Model description

Propane and natural gas operated toilets available.

Manufacturer support

One year warranty.

References and other resources

U.S. EPA (1999) Water Efficiency Technology Fact Sheet: Incinerating Toilets, EPA 832-F-99-072, Office of Water, U.S. Environmental Protection Agency, Washington DC.

3-3 Vault Toilets and Holding Tanks

Vault toilets are facilities where human waste is deposited directly into a watertight tank without flushing. The tank (i.e., vault) is typically stored below ground and may be dry or contain a sanitizing chemical. Vault toilets are commonly used by the forest service in remote, but high traffic areas. Waste material must be pumped out and hauled away periodically.

A holding tank is an underground tank that is used to collect and store wastewater. Holding tanks are used at residential and commercial locations where wastewater collection or onsite treatment is not available, such as remote areas, summer cottages, areas that are environmentally sensitive, and/or in areas that have conditions which would not permit the use of a soil adsorption system. The tanks are watertight and generally have several thousand gallons of capacity. A high water alarm or other monitoring device is used to alert the users when the tank needs to be emptied. These systems have a relatively low capital cost (about the same as a septic tank), and minimal operation cost.

Maintenance needs for vault toilets and holding tanks includes periodic emptying of the tank contents. For remote areas or in areas where pumping and hauling septage is expensive, these systems may become cost prohibitive. A rough water balance should be used to confirm that the tank is not leaking.

3-3.1 CXT Inc.

Category	Non-discharging
Technology	Vault toilet
Input	Excrement, toilet paper
Function	Storage
Applications	Remote and sensitive areas

Background/description of process

Precast concrete restroom facilities for remote areas. Toilet seat is mounted directly above concrete storage tank. Waste material must be periodically removed from the tank.



Figure 3-14

Vault toilet facilities by CXT, Inc. (Adapted From CXT, Inc.)

Contact

CXT, Inc.
 3808 North Sullivan Rd., Bldg. 7
 Spokane, WA 99216
 Phone (509) 921-8766
 Fax (509) 928-8270
 Web www.cxtinc.com

Model descriptions

Aspen Mark 11	1000 gal
Gunnison	1000 gal
Sierra	1000 gal
Tioga	2000 gal
Tioga Special	2000 gal
Vail	1000 gal

3-3.2 Romtec

Category	Non-discharging
Technology	Vault toilet
Input	Excrement, toilet paper
Function	Storage
Applications	Remote and sensitive areas

Background/description of process

Romtec designs and builds pre-engineered restroom facilities. Many models and styles are available, including both plumbed and waterless options.

Cost

Prices range from \$8,000 to 30,000 for complete facility.

**Figure 3-15**

Vault toilet facilities by Romtec, Inc. (Adapted from Romtec, Inc.)

Contact

Romtec, Inc.
 18240 North Bank Rd.
 Roseburg, OR 97470
 Phone (541) 496-3541
 Fax (541) 496-0803
 Web www.romtec.com

Model description

A wide variety of plumbed and waterless facilities.

